

REMARKS

Claims 1-43 remain pending. Claims 1, 36-39, and 42 have been amended.
Claims 44-70 are new claims and are pending.

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Applicant traverses Examiner's rejection of claims 1, 4, 6, 11, 22, 24, 28, 29, 34 and 38 per 35 USC §103(a) as being unpatentable over Huang (US-PAT 6,222,951) in view of Kovacic (US-PAT 5,793,913) further in view of Damask *et al.* (US-PAT 5,915,051). When interpreting the current invention and the prior art, it is important to understand the definitions of the terms alloy, homojunction and heterojunction. An alloy is a solid solution or compound of two or more elements. A homojunction is a junction formed of two distinct layers of one basic material where each layer has differing electrical properties. For example, a silicon homojunction may comprise a first layer of silicon containing a small concentration of p-type dopants and a second layer of silicon containing a small concentration of n-type dopants whereby the differing dopant types give rise to differing electrical properties. A heterojunction is a junction formed of alternating distinct layers of different semiconductor materials; each layer contains a different basic element, alloy or compound and each layer has different electrical properties. For example, a silicon germanium heterojunction may contain a layer of silicon and a layer of germanium; each layer has a different characteristic band-gap giving rise to differing electrical properties.

Applicant has amended claims 1 and 38 to elucidate an essential limitation of the current invention. Huang neither discloses nor suggests an essential limitation specified in claim 1 (and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and claim 38 of "a core comprised of a germanium on silicon heterojunction". Applicant respectfully argues, however, that Examiner misunderstands such reference, because Huang neither discloses nor suggests a core comprised of two distinct layers with a defined interface wherein light may be conducted through both materials. "A germanium on silicon heterojunction" as specified in claim 1 (and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and claim 38 necessarily comprises at least two distinct layers with a

defined interface wherein at least one layer is substantially silicon and at least one layer is substantially germanium. Furthermore, by specifying “a core comprised of a germanium on silicon heterojunction” in claim 1 (and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and claim 38, the current invention supports the conduction of light through both the silicon layer and the germanium layer. To clarify these essential limitations, additional text has been incorporated into claims 1 and 38. Furthermore, the photodetector disclosed by Huang is a “multi-layered silicon-germanium alloy sandwiched between silicon layers” (column 3, lines 35-36); in Huang, the photodetector and the waveguide are separate devices, comprised of separate materials that are monolithically integrated on the same substrate. In contrast, the photodetector disclosed in the current invention is formed from the waveguide core material by establishing “a plurality of conductive contacts coupled to the germanium, and a second plurality of conductive contacts coupled to the silicon” in (claim 1 and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and claim 38.

Kovacac neither discloses nor suggests a core comprised of two distinct layers with a defined interface. The silicon-germanium core disclosed in Kovacic is a “SiGe alloy core layer” (col 4, lines 9-10). Kovacic is focused on “accurate vertical and lateral positioning of hybrid optical elements” (col 2, lines 57-58). According to the current invention, very accurate vertical and lateral positioning with respect to the waveguide is not required as the photodetector in an *integrated* waveguide photodetector is fashioned from the novel waveguide core material.

Examiner refers in Office Action (page 3, lines 5-6) to Damask cladding structure. Damask discloses: “In a second materials system, both the cladding and core layers are silicon dioxide; the core layer is defined by a germanium- or phosphorus-doped layer” (col 28, lines 11-14). The use of silicon dioxide as a cladding layer is not required according to the current invention, nor is it considered a novel element of the invention. However, the use of a cladding layer such as, but not limited to, silicon dioxide, in conjunction with a “core comprised of a germanium on silicon heterojunction” in claim 1

(and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and claim 38 of the current invention is novel. Note also that according to the current invention, the core does not comprise oxide material.

5 Applicant has amended claims 36 and 37 to overcome Examiner's rejection per 35 USC §103(a) as being unpatentable over Huang (US-PAT 6,222,951) in view of Damask et al. (US-PAT 5,915,051). The amended claims explicitly clarify essential limitations of the current invention. As discussed above in Applicant's response to Examiner's rejection of claim 1 (and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and
10 claim 38, Huang neither discloses nor suggests the essential limitation of the novel core structure specified in amended claims 36 and 37.

While Damask does disclose a wavelength selective add-drop switch, the method disclosed in Damask does not incorporate the use of the novel germanium-on-silicon
15 waveguide photodetector claimed in amended claims 36 and 37.

Applicant has amended claim 39 to overcome Examiner's rejection per 35 USC §103(a) as being unpatentable over Huang (US-PAT 6,222,951) in view of Kovacic (US-PAT 5,793,913), further in view of Damask et al. (US-PAT 5,915,051), further in view of
20 Khan et al. (US 2003/0176075). The amended claim explicitly clarifies essential limitations of the current invention. As discussed above in Applicant's response to Examiner's rejection of claim 1 (and claims 4, 6, 11, 22, 24, 28, 29 and 34 dependent thereon) and claim 38, Huang neither discloses nor suggests the essential limitation of the novel core structure specified in amended claims 39 (and claim 41 dependent thereon).

25 As discussed above, Kovacic neither discloses nor suggests a core comprised of two distinct layers with a defined interface. The silicon-germanium core disclosed in Kovacic is a "SiGe alloy core layer" (col 4, lines 9-10). Kovacic is focused on "accurate vertical and lateral positioning of hybrid optical elements" (col 2, lines 57-58). According to the current invention, very accurate vertical and lateral positioning with respect to the
30 waveguide is not required as the photodetector in an integrated waveguide photodetector

is fashioned from the novel waveguide core material. As discussed above, Examiner refers in Office Action (page 5, lines 3-4) to the Damask cladding structure. Damask discloses: "In a second materials system, both the cladding and core layers are silicon dioxide; the core layer is defined by a germanium- or phosphorus-doped layer" (col 28, lines 11-14). The use of silicon dioxide as a cladding layer is not required according to the current invention, nor is it considered a novel element of the invention. However, the use of a cladding layer such as, but not limited to, silicon dioxide, in conjunction with a "core comprised of a germanium on silicon heterojunction" in amended claim 39 (and claim 41 dependent thereon) of the current invention is novel. Note also that according to the current invention, the core does not comprise oxide material. Examiner refers in Office Action (page 5, lines 4-5) to Khan's disclosure of "techniques for plasma etching silicon-germanium where the required data structure is disclosed." Khan does not disclose plasma etching of silicon layers and germanium layers as required by the current invention; he discloses plasma etching of silicon-germanium alloys. However, no silicon-germanium alloys are required elements in the current invention, so the Khan data structures are not representative of the current invention.

Applicant has amended claim 42 (and claim 43 dependent thereon) to overcome Examiner's rejection per 35 USC §103(a) as being unpatentable over Huang (US-PAT 6,222,951) in view of Kovacic (US-PAT 5,793,913), further in view of Damask et al. (US-PAT 5,915,051), further in view of Patton (5,708,739). Patton discloses "an apparatus...for forming a Bragg grating in a region of an optical waveguide" (col 5, lines 51-53). Patton refers to optical waveguides where the "central core will include a constituent that is radiation sensitive such as silicon or a dopant of germania" (col 6, lines 3-4). The mask structures disclosed in Patton with respect to silicon- or germania-containing waveguides are used to alter the optical properties of an existing optical waveguide structure based on irradiating a radiation sensitive material according to a pattern determined by the mask structure and necessarily causing damage to the structures. However, the maskworks according to the current invention are used to define the shape of the waveguide and must also define other structures apart from waveguides,

such as, but not limited to, contacts; to preserve the integrity of the germanium on silicon waveguide photodetector damage to the structures according to the current invention should be minimized; this may be especially important for the heterojunction of claim 42 (and claim 43 dependent thereon) and the adjacent integrated circuits of claim 43.

5 According to claim 43, more complex structures such as integrated circuits may be created using maskworks, according to the current invention. Patton's mask structures would not support the formation of these types of structures. Furthermore, radiation sources such as gamma rays or neutron sources cited in Patton for use with the Patton's masks in conjunction with silicon- or germania-containing waveguides would induce
10 significant damage in the novel structures of the current invention, impairing their functionality.

In the Office Action, the examiner has remarked that claims 2, 3, 5, 7-10, 12-21, 23, 25-27, 30-33, 35 and 40 "would be allowable if rewritten in independent form
15 including all of the limitations of the base claim and any intervening claims" (page 2). New claims 44-70 represent the original claims 2, 3, 5, 7-10, 12-21, 23, 25-27, 30-33, 35 and 40 rewritten to address the examiner's remarks.

New claim 44 represents original claim 2 rewritten in independent form.

New claim 45 represents original claim 3 rewritten in independent form.

20 New claim 46 represents original claim 5 rewritten in independent form.

New claim 47 represents original claim 7 rewritten to incorporate limitations and now dependent on claim 46.

New claim 48 represents original claim 8 rewritten to incorporate limitations and now dependent on claim 46.

25 New claim 49 represents original claim 9 rewritten to incorporate limitations and now dependent on claim 46.

New claim 50 represents original claim 10 rewritten to incorporate limitations and now dependent on claim 49.

New claim 51 represents original claim 12 rewritten in independent form.

New claim 52 represents original claim 13 rewritten to incorporate limitations and now dependent on claim 51.

New claim 53 represents original claim 14 rewritten to incorporate limitations and now dependent on claim 51.

5 New claim 54 represents original claim 15 rewritten to incorporate limitations and now dependent on claim 51.

New claim 55 represents original claim 16 rewritten to incorporate limitations and now dependent on claim 51.

10 New claim 56 represents original claim 17 rewritten to incorporate limitations and now dependent on claim 51.

New claim 57 represents original claim 18 rewritten to incorporate limitations and now dependent on claim 51.

New claim 58 represents original claim 19 rewritten to incorporate limitations and now dependent on claim 57.

15 New claim 59 represents original claim 20 rewritten in independent form.

New claim 60 represents original claim 21 rewritten in independent form.

New claim 61 represents original claim 23 rewritten in independent form.

New claim 62 represents original claim 25 rewritten in independent form.

New claim 63 represents original claim 26 rewritten in independent form.

20 New claim 64 represents original claim 27 rewritten to incorporate limitations and now dependent on claim 62.

New claim 65 represents original claim 30 rewritten in independent form.

New claim 66 represents original claim 31 rewritten to incorporate limitations and now dependent on claim 65.

25 New claim 67 represents original claim 32 rewritten in independent form.

New claim 68 represents original claim 33 rewritten to incorporate limitations and now dependent on claim 65.

New claim 69 represents original claim 35 rewritten to incorporate limitations and now dependent on claims 6, 44, 47, 50, 53, 54, 57, 59, 60, 61 and 67.

30 New claim 70 represents original claim 40 rewritten in independent form.

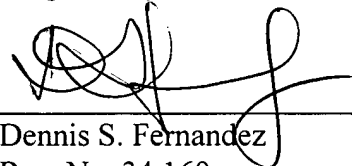
Claim 30 has been amended to explicitly introduce the "silicon waveguide" element for the purposes of readability.

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In view of the foregoing Remarks and Amendment, it is respectfully submitted by Applicants that all claims are now in condition for allowance. Reconsideration of the rejections is requested, and allowance of the claims at an early date is solicited. No additional fees are required by this paper. If the Examiner has any questions, kindly direct
10 any such queries to the following phone number or email address.

Respectfully submitted,

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